

atus), two Cape Bucephalus (*Dispholidus typus*), a Puff Adder (*Bilis arietans*) from South Africa, presented by Mr. J. E. Matcham; a Common Rattlesnake (*Crotalus durissus*), two Horrid Rattlesnakes (*Crotalus horridus*) from North America, deposited; four Common Sheldrakes (*Tadorna cornuta*), two White-fronted Geese (*Anser albifrons*), European, purchased; a Harnessed Antelope (*Tragelaphus scripta*, ♀), a Brush-tailed Kangaroo (*Petrogale penicillata*, ♂), born in the Gardens.

### OUR ASTRONOMICAL COLUMN.

NEW MINOR PLANET (1899 E.Z.).—Circular No. 25 from the Centralstelle at Kiel contains an ephemeris of the planet observed by Mr. E. F. Coddington in October and November last. Herr Kreutz thinks there seems no doubt that this is identical with the planet found by Dr. J. Palisa (1896 C.O.), and the ephemeris is given with the possibility that more observations may definitely settle the point.

Ephemeris for 12h. Berlin Mean Time.		1899.		R.A.	Decl.
		h. m. s.			
Dec. 22	...	0	58	39	...
24	...	1	0	45	...
26	...	2	56	...	4 13.3
28	...	5	12	...	3 49.7
30	...	7	33	...	3 25.8
Jan. 1 (1900)	1	10	0	...	-3 1.5

CHANGE IN PUBLICATION OF THE "ASTRONOMISCHE NACHRICHTEN."—We have received a card from Herr H. Kreutz, of the Central Bureau at Kiel, respecting an important alteration in the method of publishing the astronomical information hitherto given in the *Astronomische Nachrichten*, which is one of the most important foreign journals dealing with current astronomical observations. With the beginning of the New Year the original publication will be confined to the recording of general observations, while a separate paper will be issued to contain the ephemerides of comets, planets, &c. The subscription to the new part will be 10 marks yearly. Arrangements are being made for this addition at Kiel, Niemannsweg 103, and subscriptions should be sent there direct.

COMPANION TO THE OBSERVATORY.—We have received the *Companion to the Observatory* for the year 1900. In arrangement this closely resembles those of previous years, giving most of the more important data for the observation of celestial objects. Beginning with one page showing for every week the time of rising and setting of the sun, its declination at noon, mean and sidereal time, and the moon's phases, there follows a calendar, giving for every day in the year the setting, southing, declination of the moon and the longitude of its terminator. Mr. Denning again contributes his list of radiant points of the principal meteor showers during the year. Then follow useful particulars of the R.A., Decl., diameters, times of rising, southing and setting of the planets, with the times of elongation, opposition, conjunction, &c. Occultations, configurations of the satellites of Jupiter, Saturn, Uranus and Neptune occupy the next ten pages. Mr. Crommellin contributes an ephemeris of Eros for the period about the opposition in December. The rest of the book is occupied with an ephemeris for physical observations of the sun, and the mean places and times of maxima and minima, of the more noticeable variable stars.

### RECENT RESEARCHES ON URIC ACID.

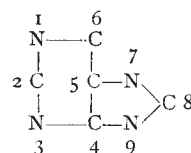
THE uninterrupted stream of new researches which has issued from the laboratory of Prof. Emil Fischer at Berlin since 1895 threatens to bewilder even the careful student of chemistry or physiology. The following brief summary of the results may be found useful.

Uric acid is an excretory or waste product of animal life, and is closely related chemically to many substances such as paraxanthine and heteroxanthine, which are associated with it in urine; xanthine, adenine, and guanine, which probably form part of the nucleins of cells, and theobromine, theophylline and caffeine, the physiologically active constituents of tea, coffee and cocoa.

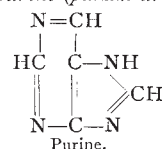
An accurate knowledge of the constitution of these substances is therefore of the first importance to physiologists, whilst a satisfactory process for utilising uric acid—which is a

plentiful constituent of guano—in the synthesis of theobromine or caffeine would possess considerable therapeutic interest as well as commercial value. The many difficulties encountered by Prof. Fischer in the solution of these problems have been met with his accustomed skill and resource, which are the admiration and despair of the present-day chemist, and we are now not only in possession of a clear and complete knowledge of the relationship which exists between these complex products of animal and plant life, but we may anticipate before long their appearance as commercial products.

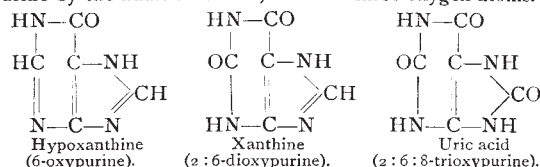
Fischer has shown that in all these compounds the same atomic framework is present and may be represented as follows, the relative position of the atoms being denoted by the numbers 1 to 9.



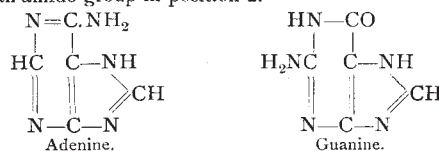
If the four additional hydrogen atoms necessary to satisfy the valencies of the carbon and nitrogen atoms be now added, the structure of the mother substance of the whole series is obtained, a compound which has been actually prepared by Fischer, and named *purine* (*purum uricum*).



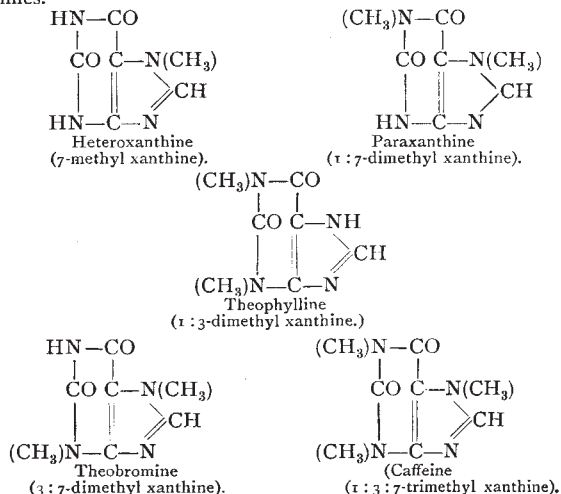
Hypoxanthine, xanthine and uric acid may be derived from purine by the addition of one, two and three oxygen atoms.



Adenine is purine in which the hydrogen atom in position 6 is replaced by an amido-group, whilst guanine is hypoxanthine with an amido-group in position 2.



Heteroxanthine, theophylline, paraxanthine, theobromine and caffeine are respectively mono-, di- and tri-methyl xanthines.

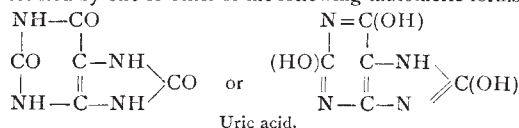


Although most of the natural products are represented in the foregoing formulæ, the list of purine derivatives is not exhausted; for, as in the case of the sugars, the natural products have been supplemented by an even longer list of artificial compounds. Thus 4 monomethyl, 5 dimethyl and 2 trimethyl xanthines are possible, and most of them are known, and all the fifteen theoretically possible methyl derivatives of uric acid have been prepared together with an additional one, whose existence has not yet been accounted for.

Even this does not complete the list of purine derivatives, for there remain methyl purines, methyl adenines and methyl hypoxanthines still to record, as well as an 8-oxypurine isomeric with hypoxanthine and a 6:8-dioxypurine isomeric with xanthine, and many others.

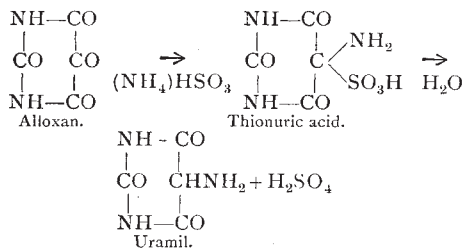
It now remains to indicate the manner in which the constitution of these substances has been determined and their synthesis effected.

The structure of uric acid was pretty clearly established in the year 1884 by Fischer's discovery of a second methyl uric acid, in addition to the one obtained by Hill, both of which are formed simultaneously by treating the lead salt of uric acid with methyl iodide. Since one of these compounds gives on oxidation methyl alloxan and urea, and the other by similar treatment alloxan and methyl urea, the formula of uric acid must be represented by the fusion of an alloxan and a urea nucleus, so as to form an unsymmetrical grouping after the manner proposed by Medicus. The complete methylation of uric acid yields a tetramethyl derivative from which all the nitrogen is removable in the form of methylamine. It follows, therefore, that the four methyl groups in tetramethyluric acid, and probably therefore the four hydrogen atoms in uric acid itself, are linked to nitrogen. The structure of uric acid is represented by one or other of the following tautomeric forms:—

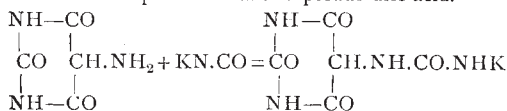


This structure is confirmed by its synthesis from uramil, a synthesis which, it may be interesting to remember, was first suggested by Liebig and Wöhler, then carried forward a step by v. Baeyer's discovery of pseudo-uric acid, and finally realised by Fischer in 1895.

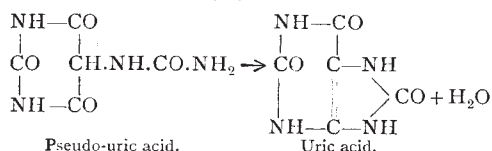
Uramil was first obtained by Liebig and Wöhler from alloxan and ammonium sulphite, which form together thionuric acid, the latter decomposing on boiling with hydrochloric acid into uramil.



Uramil, as v. Baeyer showed, combines with potassium cyanate to form the potassium salt of pseudo-uric acid.



Pseudo-uric acid differs in composition from uric acid by one molecule of water. To effect its removal, which the usual dehydrating agents fail to do, Fischer found that it is only necessary to heat the compound with 20 per cent. hydrochloric acid in order to obtain uric acid.



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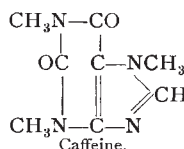
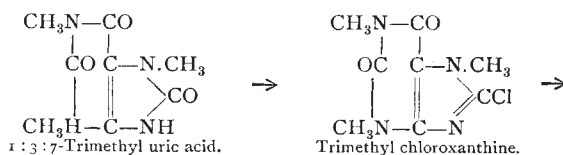
If in place of uramil its methyl derivatives are employed, various methyl uric acids are obtained; an important point, since the positions of the methyl groups in the acid are thereby determined.

Thus from 1 and 7-monomethyl uramil, 1 and 7 methyl uric acid have been obtained; 1:3- and 1:7-dimethyl uramil yield 1:3- and 1:7-dimethyl uric acid; 1:3:7-trimethyl uramil can be converted into trimethyl uric acid, whilst the imido pseudo-uric acid of Traube is converted into an amido-uric acid.

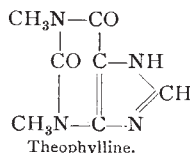
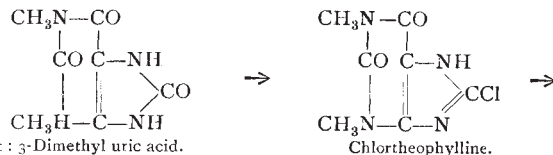
Having then established the structure of uric acid and the methyl uric acids as hydroxy-derivatives of xanthine, guanine, theobromine, theophylline and caffeine, &c., the question arises, How can these various compounds be obtained from the single raw material, uric acid? Since xanthine can be methylated and converted into theobromine, as Strecker first showed by treating the silver salt with methyl iodide, and since theobromine and theophylline, by a repetition of the same process, can be converted into caffeine, there are several ways in which the above problem might be attacked.

Uric acid might be reduced to xanthine and the xanthine methylated, or uric acid might be converted into monomethyl uric acid, then reduced to monomethyl xanthine and further methylated; or, finally, the di- and tri-methyl uric acids might be first prepared and then reduced to the corresponding di- and tri-methyl xanthines. All three methods have been utilised in turn by Fischer and carried to a successful issue; and since the process is similar in each case, one or two examples may suffice by way of illustration.

When 1:3:7-trimethyl uric acid is heated with a mixture of pentachloride and oxychloride of phosphorus, it yields trimethyl chloroxanthine. Tetramethyl uric acid yields the same product by the elimination of a methyl group in the form of methyl chloride. Trimethylchloroxanthine is then reduced with strong hydriodic acid to caffeine.



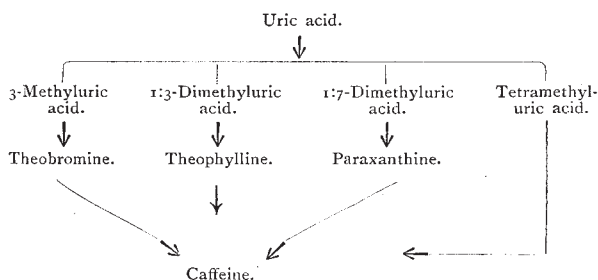
1:3-Dimethyl uric acid behaves similarly and forms theophylline.



This process cannot, however, be applied to uric acid in order to obtain xanthine, or to 3 or 7 monomethyl or 3:7-dimethyl uric acid, which might lead to the synthesis of theobromine; since in the first case the substance is destroyed, and in the other cases the chlorine atom replaces the wrong oxygen atom, *i.e.* instead of replacing it in position 8, which is essential to the success of the operation, it enters position 6.

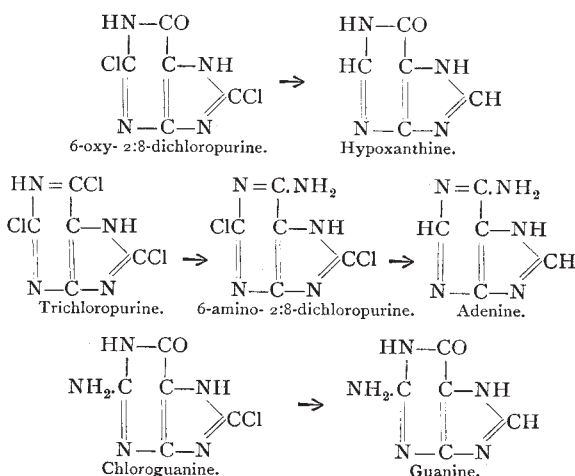
The happy idea of employing phosphorus oxychloride alone in place of the mixture of pentachloride and oxychloride has overcome this unforeseen difficulty, and given a fortunate turn to the investigation.

By this modification 3:7-dimethyl uric acid may be made to yield chlorotheobromine and theobromine, or better still, 3-methyl uric acid, which can be obtained by the direct methylation of uric acid, may be converted successively into 3-methyl-8-chloroxanthine, which may be either methylated with methyl iodide in presence of caustic potash to chlorotheobromine and chlorocaffeine, and then reduced, or first reduced to 3-methyl xanthine and then methylated. As a rule, however, the methylation of the chlorine compound is more easily effected than that of the reduced product. Paraxanthine (1:7-dimethyl-xanthine) may be obtained from 1:7-dimethyl uric acid in a similar manner and also converted by methylation into caffeine. The following scheme will make clear the various directions in which the synthesis of caffeine has been accomplished:—

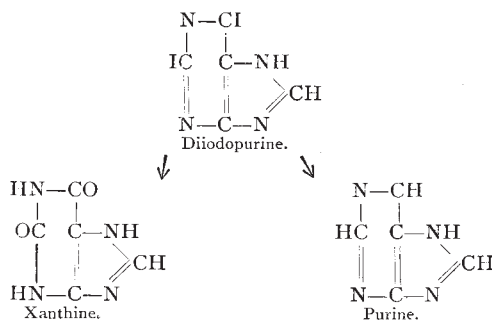


Heteroxanthine (7-methyl xanthine) has been obtained by the action of phosphorus oxychloride on theobromine, which by the elimination of one methyl group forms 7-methyl dichloropurine. By boiling this substance with hydrochloric acid, 7-methyl xanthine is formed. Xanthine cannot be prepared in so direct and simple a manner as the above from uric acid, even when phosphorus oxychloride alone is used, for the first product obtained in this way is 8-oxy-2:6-dichloropurine instead of 8-chloro-2:6-dioxypurine; but by the action of a large excess of phosphorus oxychloride uric acid may be made to part with its last atom of oxygen. Trichloropurine is then produced, and this compound has served for the synthesis of xanthine and its more nearly related derivatives hypoxanthine, adenine and guanine.

When trichloropurine is treated with aqueous potash it yields 6-oxy-2:8-dichloropurine. The latter compound may be directly reduced with hydriodic acid to hypoxanthine, or converted with alcoholic ammonia into chloroguanine, which on reduction forms guanine. Aqueous ammonia converts trichloropurine into 6-amino-2:8-dichloropurine, which yields adenine on reduction.



With strong hydriodic acid, trichloropurine is converted into diiodopurine, which yields, on the one hand, with hydrochloric acid xanthine, and with zinc dust and water purine, the mother substance of the whole group of compounds. Though neutral to litmus, purine forms salts, the nitrate and picrate being the most characteristic of these compounds.



### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. FRANK LENEY, of the Geological Department of the British Museum (Natural History), who has been trained under Mr. Smith Woodward, has been appointed Assistant Curator of the Norwich Museum.

MR. A. RENDLE SHORT, a student of University College, Bristol, was awarded the scholarship in physiology at the recent final B.Sc. examination of London University. The scholarship is of the value of 50*l.* per annum for two years.

DR. J. W. GREGORY has been appointed professor of geology and mineralogy in the University of Melbourne, in succession to Sir Frederick M'Coy, F.R.S. Dr. Gregory has been an assistant in the geological department of the British Museum (Natural History) for several years, and is a member of the council of the Geological Society. He has been engaged in very successful explorations—notably in British East Africa in 1892-93, and in Spitsbergen in 1896—and has, in addition, contributed more than fifty papers to scientific societies. The salary attached to the post to which he has been appointed is 1000*l.* a year.

THE London Technical Education Committee have arranged for a second conference of science teachers to be held during the forthcoming Christmas vacation. Meetings will be held on Wednesday, January 10, and Thursday, January 11, 1900, in the morning and afternoon of each day. On the first day the meetings will be held in the conference room of the English Education Exhibition at the Imperial Institute, when the Rt. Hon. Sir John Lubbock, F.R.S., will preside at the morning meetings, and Sir Henry Roscoe, F.R.S., at the afternoon gatherings. The second day's proceedings will take place at the Shoreditch Technical Institute, Pitfield-street, Hoxton. The following addresses will be delivered:—Wednesday at 11 a.m., "Teaching of Botany in Schools," by Prof. L. C. Miall, F.R.S., and "Object Lessons in Botany," by Miss Von Wyss; at 2 o'clock, on "Juvenile Research," by Prof. H. E. Armstrong, F.R.S., this address will be illustrated with lantern slides and experiments by juvenile assistants; on Thursday at 11 a.m., on "Teaching of Natural History in Schools," by Prof. Woods Hutchinson, and on "Object Lessons in Natural History," by Mr. J. W. Tutt; at 2 o'clock, "Metal Work as a Form of Manual Instruction in Schools," by Prof. W. Ripper. Free admission will be granted to as many teachers as the conference rooms will accommodate. Applications for tickets of admission should be made to Dr. Kimmins, Bermondsey Settlement Lodge, S.E., or to Mr. C. E. Buckmaster, 16, Heathfield-road, Mill Hill Park, W.

THE following gifts to science and education in the United States are announced in *Science*:—The money, amounting to 11,400,000 dollars, obtained by Mrs. Jane Stanford for her 285,000 shares of Southern Pacific stock, which she sold recently, will at once be made available for the use of the Stanford University.—Mr. James Jennings McComb, of New York, one of the founders of the South-western Presbyterian University at Clarksville, Tenn., has given 70,000 dollars to the endowment fund, making his contributions amount in all to 100,000 dollars.—Brown University has received an unconditional gift of 10,000 dollars from the heirs of the late Lucian Sharpe.—The Rev. John Pike has left the reversion of half his property to found two scholarships in Bowdoin College.—Mr. Thomas Armstrong, of Plattsburg, New York State, who